Assessment of Factors Affecting Readmission and Care Integration in Inpatients with Diabetes and Cardiovascular Disease

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HEALTH AND MEDICAL SCIENCES In

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Abstract

Background

Multimorbidity and polypharmacy are serious and prevalent issues, both lead to poor health outcomes such as readmission to hospital and adverse drug reactions. Diabetes and cardiovascular diseases are commonly comorbid conditions which often lead to patients with polypharmacy and multiple hospital admissions.

Methods

A prospective cohort study enrolled older diabetic patients with cardiovascular disease from a single tertiary care hospital. Demographic, clinical, psychologic, and pharmacological data were collected. Several assessments were applied to discharge medication lists. Univariate and multivariate analyses were performed to assess which factors were associated with time to readmission and readmission in 30-days.

Results

Of 100 participants 47% were readmitted during the study and 30% of those were within 30-days. 97% of participants had polypharmacy and median scores for the Beers Criteria and Anticholinergic Risk Scale were both 0. There were no significant differences between readmitted and not readmitted participants but associations between DASS stress ($p=0.041$) and confidence in medications ($p<0.001$) with time to readmission were observed.

Conclusion

The population was biased to more complicated patients and although polypharmacy was highly prevalent, medications were largely appropriate and not associated with readmission rates. Noise surrounding the outcome measure of readmission may have contributed to a lack of expected results. Further research is required with a larger sample size and more heterogenous population to accurately assess the effects of polypharmacy.

(223 words)

Assessment of factors affecting readmission and care integration in inpatients with diabetes and cardiovascular disease

Introduction

The ageing population is leading to higher rates of people living with multimorbidity or more than one chronic condition. In Australia, the prevalence of multimorbidity has been estimated at 37.1% which increased drastically to 83.2% in Australians aged ≥75.[1] Multimorbidity is also associated with polypharmacy which is regularly defined as 5 or more regular medications.[2, 3] Polypharmacy can lead to an increased risk of inappropriate medications, adverse drug reactions, hyperpolypharmacy (≥10 regular medications) and reduced compliance due to complex medication regimens.[2, 4, 5] Polypharmacy and increased medication numbers have also been shown to be associated with readmission.[6, 7]

Diabetes Mellitus and Cardiovascular Diseases are commonly comorbid conditions due to their similar pathological basis.[8] In 2013 it was estimated that there was 382 million people with diabetes worldwide, which was projected to increase to 592 million by 2035.[9] Research has shown 90% of patients with type 2 diabetes have at least one other chronic condition; with hypertension in 66% and heart disease in 25% as the most common.[3] Diabetics with comorbidities of cardiovascular diseases were shown to be twice as likely to have polypharmacy and were also associated with a higher risk of hospital admissions and health costs.[10] Furthermore polypharmacy due to diabetes has been found to be a risk factor for medication errors in hospital.[11]

Multimorbidity is associated with high health care costs and admissions to hospital.[12] Furthermore, research shows that diabetic patients and people with cardiovascular diseases have increased rates of readmission to hospital.[13-16] However, increased health care expenditure and utilisation doesn't always lead to better outcomes and care as many patients are still experiencing poor health outcomes.[17] There is evidence for 30-day readmission being associated with increased numbers of medications in older populations[7] and readmission has been associated with both recent admissions and certain diabetes treatments in patients with diabetes hospitalised for cardiovascular disease.[15] Readmission within 30-days tends to be the outcome of interest but chronic conditions need long term follow up as well.[14, 15, 18, 19] It is clear that diabetes and cardiovascular disease are both prevalent and these conditions are place a large burden on health care

systems worldwide.[20] Care integration aims to coordinate care between healthcare systems and often involves multidisciplinary interventions. There is evidence for the effectiveness of this in people with diabetes and cardiovascular diseases[17]. However, such interventions are expensive, and when given to groups with lower risk it can result in no benefit to the patient and therefore wasted time and resources.[21]

Most prior research has been retrospective which provides useful and worthwhile information however limits the data and assessments which can be collected, and therefore, the conclusions drawn. This means there is still a gap in the knowledge about how to best coordinate the care for people with diabetes and cardiovascular disease and which factors contribute to outcomes such as readmission in people with both conditions. Understanding what leads to readmission in these individuals is paramount in order to effectively design and target care integration interventions to reduce them.

Hypothesis

It is hypothesised that polypharmacy is more important than demographical, physical, social, and psychological factors in assessing readmission in inpatients with cardiovascular disease and diabetes.

Aims:

- To review physical, social, psychological, and pharmacological factors in inpatients with diabetes and cardiovascular disease to determine if they affect care integration measured by readmission and follow up questionnaires.
- To assess short term care integration, through 1-month follow up questionnaires and readmission within 30 days.
- To assess long term care integration, through 6-month follow up questionnaires and readmission data for the duration of the project.
- To assess prescribing of potentially inappropriate medications in the study population
- To identify, within the population of interest, if there is a subset of individuals who are at greater risk of poor outcomes and should therefore be targeted for future interventions of care integration

Methods

Study population

Participants were prospectively enrolled over the study period from the Royal Adelaide Hospital. The population of interest was patients with Diabetes Mellitus and any form of cardiovascular disease aged 50 or older, discharged alive and not to high level residential aged care. Other inclusion criteria were the ability to provide written informed consent and comply with study procedures as well as having sufficient English language skills to answer study questions. Patients were excluded if they had palliative intent, delirium or other cognitive impairment which would interfere with consent and study assessments, were admitted from or likely to be discharged to high level residential aged care facilities or those whose clinical team felt should not be approached. Patients were identified through Allscripts Sunrise Electronic Health Record (Sunrise) (Allscripts, Chicago, IL) by filtering for glycated haemoglobin (HbA1c) blood tests to identify diabetic patients. Medical records were checked for age, a diagnosis of any form of cardiovascular disease and their residential status. A nurse involved in their care was then approached to confirm eligibility. Pharmacists on wards of interest were also involved in identifying and recruiting participants. Once deemed eligible, patients were approached, informed about the study and invited to participate.

Data Collection

Baseline data were collected after consent and during the initial admission where possible. If participants were discharged before data collection was completed, the remaining assessments were completed over the phone or sent in the mail. Participants were asked how many general practitioners, pharmacies, and specialists they had seen in the last 12 months and whether they had received a Home Medicines Review or Chronic Disease Care Plan. Frailty was assessed using a modified Reported Edmonton Frail Scale as described by Hilmer et al[22], as well as the Clinical Frailty Scale and Barthel's Index. Questions and assessments were completed verbally. Participants were then given the 21-item Depression Anxiety and Stress Scales (DASS21)[23] and the Multidimensional Health Locus of Control to assess which factors participants believe control their health[24]; these were left with participants to complete in their own time. Comorbidities were collected from Sunrise or case notes, totalled and analysed according to the Charlson Comorbidity Index.[25] Open Architecture Clinical Information System (OACIS) v 7.1.0.106 (OACIS, Telus Health, Longueuil, Canada) was used to gather latest blood test results, and final discharge dates to

determine length of stay (LOS). When participants were transferred to another hospital, rehabilitation facility, or Hospital at Home, their discharge from these services was recorded as their final discharge date but the time spent there was not included in the LOS.

Medication Assessments

The total number of regular discharge medicines and administrations per day were counted, excluding medications which were prescribed for a short period after discharge, or to be taken as required. Polypharmacy was considered ≥5 regular medications and ≥10 regular medications was labelled as hyperpolypharmacy as these are common in the literature.[6, 7, 26] Both the 2015[27] and 2019[28] updated American Geriatrics Society Beers Criteria were used to determine if participants were taking potentially inappropriate medications; medications which had recommendations in multiple categories were only counted once per participant. Where the Beers criteria recommended dose reductions but lacked clarity the Therapeutic Goods Administration (TGA) approved product information and Australian Medicines Handbook[29] were used to determine whether the dose was appropriate. The Drug Burden Index (DBI) was calculated to assess anticholinergic and sedative burden[30], and the Anticholinergic Risk Scale was applied to each medication list to assess anticholinergic load.[31] These assessments have been widely used and validated to assess medication use in older persons.[6, 26, 32, 33]

Outcome Measures

The primary outcome measure was time to readmission; OACIS was used to determine if and when participants were readmitted, and all unplanned readmissions were included. Initially emergency department (ED) presentations were included as a readmission however after initial analyses it was decided to exclude emergency department presentations and re-analyse the data to make this outcome measure clearer. Secondary outcomes were readmission within 30 days and responses to follow up questionnaires. Participants were sent follow-up questionnaires 1-month and 6-months after discharge to assess their experiences of care integration in the primary healthcare system. Participants were asked “how confident are you in the purpose of taking each of your medications?” on a 5-point Likert scale from “not confident at all” to “completely confident”, similar to one described by Arinzechukwu et al.[34] at 1 month. At 6 months participants were sent the 20-item Patient Assessment of Care for Chronic Conditions[35], from which question

5 “over the past 6 months I was satisfied that my care was well organised” rated on a 5-point Likert scale from “none of the time” to “always” was analysed. For participants who were lost to follow up the censor date recorded was their last form of contact, either with follow up assessments or with the hospital through outpatient appointments, to avoid survivor bias.

Statistical Analysis

Data were analysed with SPSS version 25 (IBM Corp, Armonk NY, USA). The non-parametric one-sample-Kolmogorov-Smirnov test was used to determine if data were normally distributed. To assess for differences between the group which were readmitted and those who were not several tests were used. Scale data which were not normally distributed were analysed by the non-parametric independent samples Mann-Whitney U test. Scale data which were normally distributed were analysed by the independent samples T-test and nominal and ordinal variables were analysed using a Chi-square test. Univariate survival analyses of time to readmission for were performed using a Kaplan-Meier analysis. The results of these Kaplan-Meier analyses which were significant or near significant ($p<0.2$) were used in a backward stepwise Cox Regression multivariate analysis for time to readmission and a multivariate binary Logistic Regression for readmission within 30 days.

Ethical Considerations

This study was approved by the Central Adelaide Local Health Network Human Research Ethics Committee reference number: R20190301. All participants gave written informed consent and were given a copy of their signed consent form.

Consort diagram

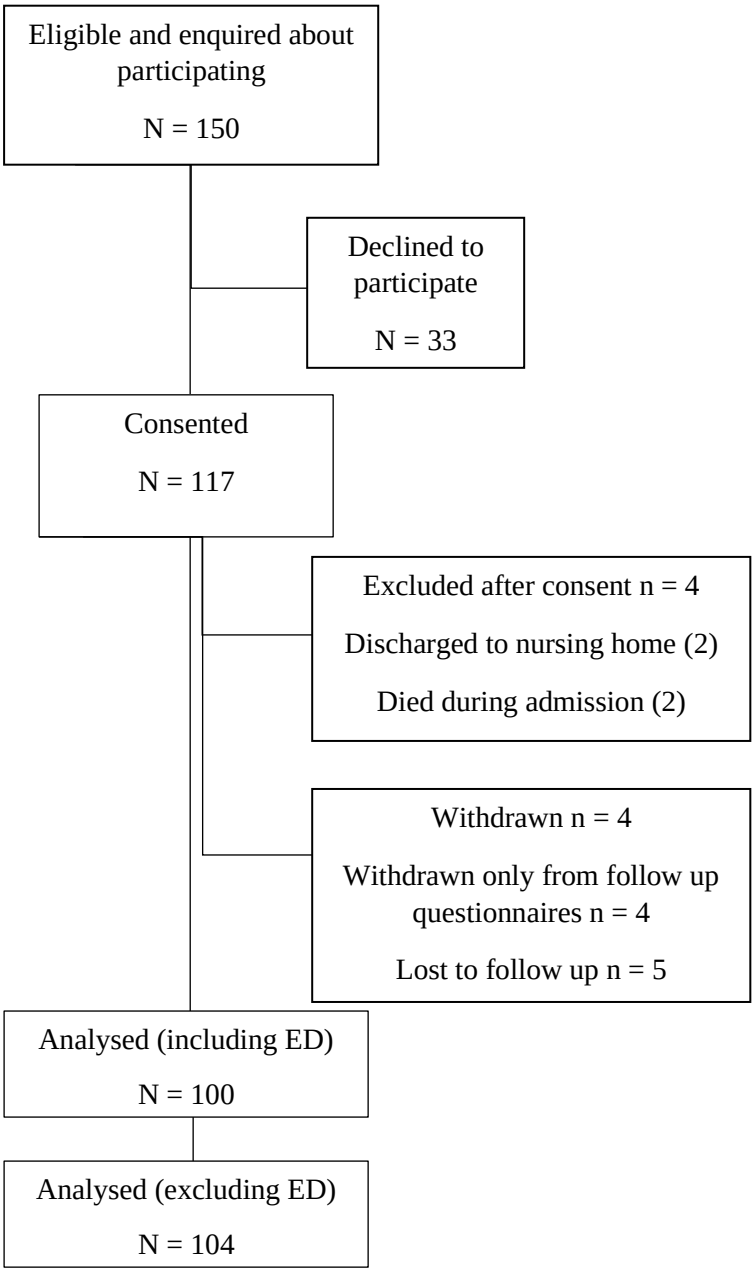

Figure 1. CONSORT diagram showing participants recruited for the study

Results

Including Emergency Department Visits

A total of 117 participants were recruited, after exclusions and withdrawals, data for 100 participants were analysed. 47% participants were readmitted during the study with 30% being within 30 days of discharge. The 1-month follow-up questionnaire was returned by 80% of participants and 28% completed the 6-month questionnaire. The baseline demographics and clinical characteristics of the study population are displayed in Table 1, scale variables are presented as median (Interquartile range (IQR)) and nominal and ordinal data as n (%). Statistical significance was set at $p \leq 0.05$.

The median age was 68 (IQR 61.3, 77.0) and 33% were female. 75% of the index admissions were due to any complication of diabetes and the median length of stay was 7.5 days (IQR 4.0, 14.8). The cohort was highly multimorbid with the median number of conditions being 7 (IQR 5, 9.8), the median Charlson score was 3.0 (IQR 2.0, 5.0). None of the variables collected were significantly different between those readmitted during the study and those who were not. Individual comorbidities were also not found to have any relationship to readmission.

Table 1. Demographic and clinical characteristics of the study population split by readmitted and not readmitted.

	Readmitted During Study (n = 47)	Not Readmitted (n =53)	Overall (n = 100)	P value
Age at consent	68.0 (64.0, 78.0)	66.0 (60, 77.0)	68.0 (61.3, 77.0)	NS
Gender, (n female (%))	13.0 (27.7)	20.0 (37.7)	33 (33.0)	NS
Total number of comorbidities	7.0 (5.0, 10.0)	7.0 (5.0, 9.0)	7.0 (5.0, 9.8)	NS
Charlson Comorbidity Index	4.0 (2.0, 5.0)	3.0 (2.0, 5.0)	3.0 (2.0, 5.0)	NS
Location, (n rural (%))	13.0 (27.7)	19.0 (35.8)	32 (32.0)	NS
Living situation alone with someone	18.0 (38.3)	19.0 (36.5) *n = 52	37 (37.4) 62 (62.6) *n= 99	NS
Country of birth Australia English speaking	34.0 (73.9) 38.0 (82.6) *n= 46	34.0 (68.0) 42.0 (84.0) *n =50	68 (70.8) 80 (83.3) *n = 96	NS
Smoking status current ex-smoker never smoked	2.0 (5.0) 24.0 (60.0) *n = 40	8.0 (16.7) 24.0 (50.0) *n = 48	10 (11.4) 48 (54.5) 30 (34.1) *n = 88	NS
Number of GP practices	1.0 (1.0, 2.0) *n = 42	1.0 (1.0, 1.0) *n = 48	1.0 (1.0, 2.0) *n = 90	NS
Number of pharmacies	1.0 (1.0, 2.0) *n = 43	1.0 (1.0, 2.0) *n = 49	1.0 (1.0, 2.0) *n = 92	NS
Number of specialists	1.0 (0.0, 4.0) *n = 43	1.0 (0.0, 3.0) *n = 48	1.0 (0.0, 3.0) *n= 91	NS
Initial LOS	7.0 (4.0, 19.0)	8.0 (4.0, 14.5)	7.5 (4.0, 14.8)	NS
Home Medicines Review	8.0 (18.6) *n = 41	8.0 (16.3) *n = 49	16 (17.4) *n = 92	NS
Chronic Disease Care plan	18.0 (41.9) *n = 43	19.0 (38.8) *n = 49	37 (40.2) *n = 92	NS
BMI	28.3 (25.7, 34.7) *n = 40	29.5 (25.9, 36.2) *n = 48	28.9 (25.8, 35.2) *n = 88	NS
HbA1c	7.5 (6.4, 9.4) *n = 43	7.9 (7.3, 9.5) *n = 51	7.6 (6.9, 9.5) *n = 94	NS
Creatinine	91.0 (78.0, 179.0)	92.5 (62.3, 129.8) *n = 52	92.0 (66.0, 153.0) *n = 99	NS
Haemoglobin	115.0 (102.0, 132.0)	113.0 (98.0, 132.0)	114.0 (101.0, 131.8)	NS
LDL	1.5 (1.0, 2.1) *n = 34	1.5 (1.0, 1.9) *n = 38	1.5 (1.0, 2.0) *n = 72	NS
HDL	1.0 (0.7, 1.3) *n = 34	0.9 (0.7, 1.3) *n = 38	0.9 (0.7, 1.3) *n = 73	NS
eGFR	61.0 (35.0, 89.0)	62.0 (39.0, 90.0)	61.5 (36.5, 90.0)	NS
Creatinine Clearance	67.9 (41.3, 109.3) *n = 43	84.6 (40.6, 139.3) *n = 48	77.8 (41.3, 119.3) *n = 91	NS

Medication details are summarised in table 2; participants were discharged with a median of 10 regular medications (IQR 7, 12), 97% had polypharmacy and 52% had hyperpolypharmacy. The median scores for both versions of the Beers Criteria were 0 (IQR 0.0, 1.0) similarly, the median ARS score was 0 (IQR 0, 0). Polypharmacy was assessed at baseline as part of the Edmonton frailty scale and more participants reported taking less than 5 medications than was observed when totalling discharge medications, as such, 'new polypharmacy' was observed in 17.5% of participants. However, this had no observed effect on readmission.

Table 2. Summary of medication details and assessments split by readmitted and not readmitted.

	Readmitted During Study (n = 47)	Not Readmitted (n =53)	Overall (n = 100)	P value
Number of discharge medicines	10.0 (7.0, 12.0)	10.0 (8.0, 12.0)	10.0 (7.0, 12.0)	NS
Number of administrations per day	13.0 (9.0, 17.0)	14.0 (10.0,17.0)	13.0 (9.3, 17.0)	NS
Polypharmacy	45.0 (95.7)	52.0 (98.1)	97 (97.0)	NS
Hyperpolypharmacy	25.0 (53.2)	27.0 (50.9)	52 (52.0)	NS
New polypharmacy	9.0 (19.6) *n=46	8.0 (15.7) *n=51	17 (17.5) *n = 97	NS
Number of 2019 Beers drugs	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	NS
Number of 2015 Beers drugs	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	0.0 (0.0, 1.0)	NS
Anticholinergic Risk Scale	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	NS

The results of the frailty and psychological assessments are summarised in table 3. The cognition element of the Edmonton Scale was frequently incomplete and as such was been reported with and without this subscale.

Table 3. Summary of frailty and psychological assessments split by readmitted and not readmitted.

	Readmitted During Study (n = 47)	Not Readmitted (n =53)	Overall (n = 100)	P value
Edmonton Frailty Scale Total Total without cognition	 6.0 (5.0, 9.0) 6.0 (5.0, 7.0)	 7.0 (5.0, 8.0) 5.0 (4.0, 7.0)	 7.0 (5.0, 8.0) 5.5 (4.0, 7.0)	NS
Barthel's Index	95.0 (83.8, 100.0) *n = 46	95.0 (83.8, 100.0) *n = 50	95.0 (85.0, 100.0) *n = 96	NS
Clinical Frailty Score	4.0 (4.0, 5.0) *n = 44	4.0 (3.0, 5.0) *n = 50	4.0 (3.0, 5.0) *n = 94	NS
DASS21 Depression	2.0 (1.0, 5.0) *n = 35	4.0 (2.0, 7.5) *n = 41	3.0 (1.0, 6.0) *n = 76	NS
DASS21 Anxiety	4.0 (2.0, 7.0) *n = 35	5.0 (2.5, 7.0) *n = 41	4.0 (2.0, 7.0) *n = 76	NS
DASS21 Stress	2.0 (0.0, 6.0) *n = 35	4.0 (2.0, 9.0) *n = 41	4.0 (1.0, 8.0) *n = 76	NS
LoC Internal	24.0 (18.8, 29.3) *n = 34	25.0 (23.0, 29.3) *n = 42	25.0 (21.0, 29.0) *n = 76	NS
LoC Chance	17.5 (12.0, 23.3) *n = 34	17.0 (13.8, 24.0) *n = 42	17.0 (13.3, 24.0) *n = 76	NS
LoC Powerful Others	23.5 (16.8, 27.3) *n = 34	24 (21.8, 28.3) *n = 42	24.0 (19.3, 28.0) *n = 76	NS

Univariate Kaplan-Meier survival analyses of time to readmission produced some significant results. Figure 2 displays the overall survival function for time to readmission.

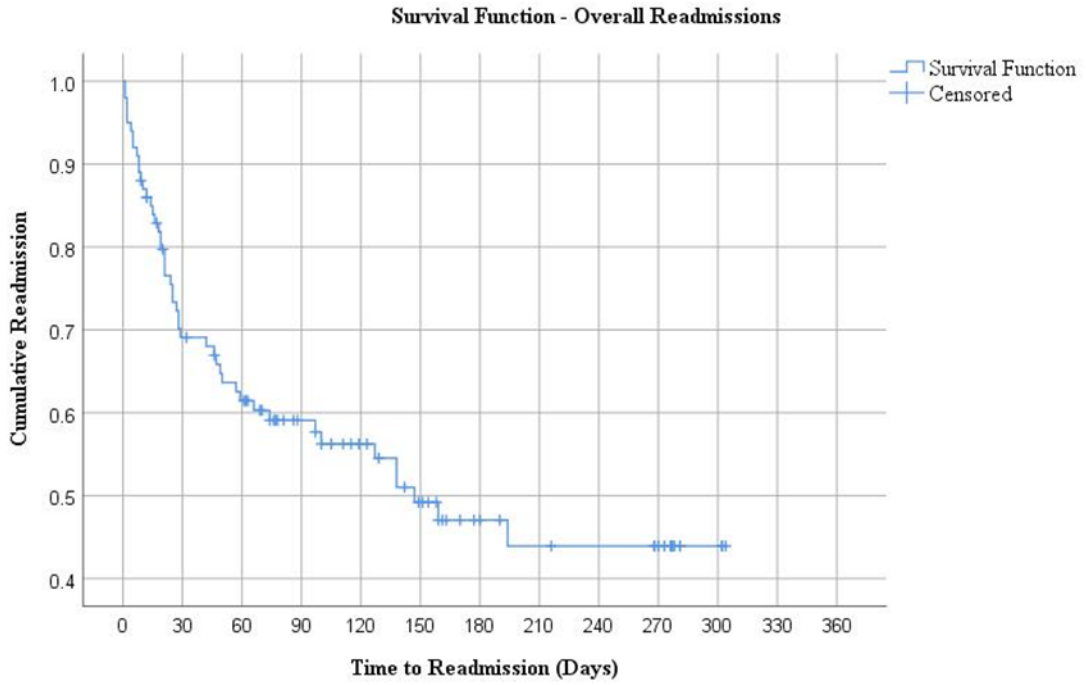

Figure 2. Kaplan Meier curve showing the time to readmission over the study period.

Kaplan-Meier analyses of key variables revealed that the stress subscale on the DASS21 (figure 3) assessment was significantly associated with time to readmission (p = 0.41).

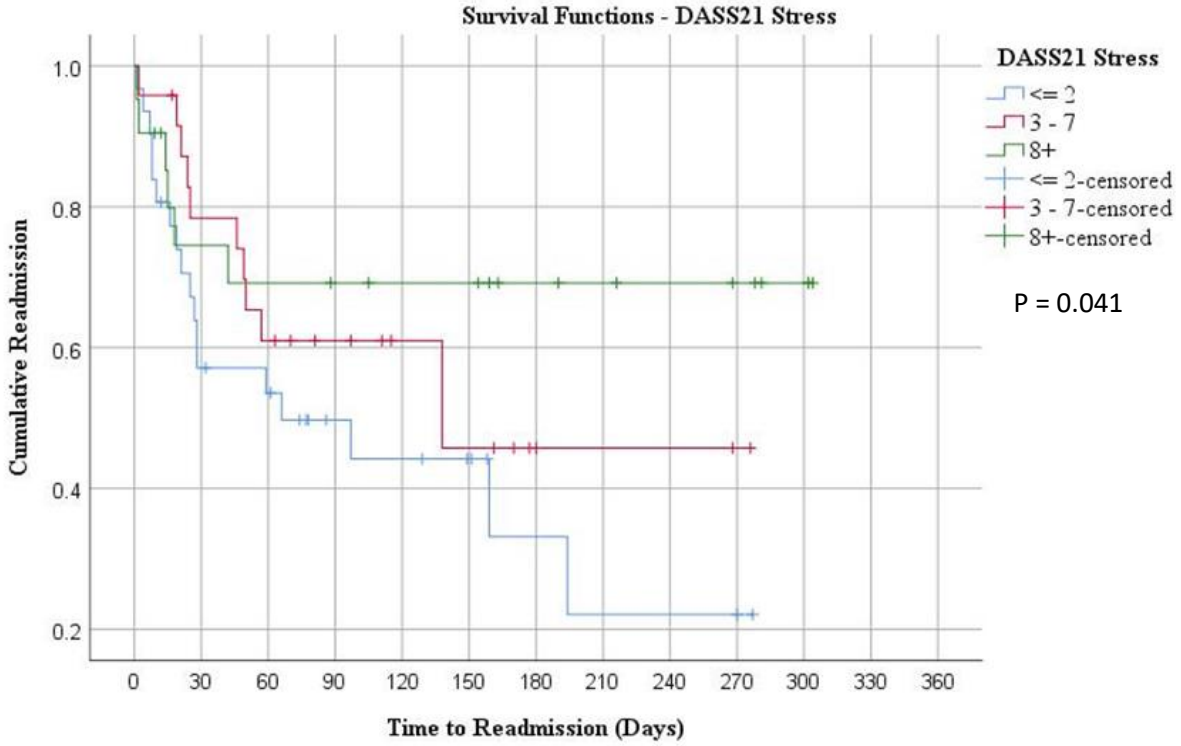

Figure 3. Kaplan Meier curve showing the time to readmission for tertile scores of the DASS stress subscale n = 76, p = 0.041.

The curve shown in figure 3 indicated that a score of 2 or less, or the least amount of stress, was significantly associated with a shorter readmission free survival time. No other variables were significantly associated with time to readmission in Kaplan-Meier analyses however several variables were near significant (p<0.2). The results of a multivariate Cox Regression analysis of these near significant variables are displayed in table 4.

Table 4 Results of the multivariate Cox Regression analysis of time to readmission for n=79.

	Hazard Ratio	95% Confidence Interval	P Value
Hypertension	2.292	1.004 – 5.231	0.049
Rural	0.473	0.234 – 0.954	0.037
1-Month Purpose of Medications	0.727	0.540 – 0.979	0.036
Functional Performance	1.502	1.098 – 2.054	0.011

This model suggests when these factors are present together, hypertension and lower functional performance as assessed by the Edmonton Scale are associated with an increased hazard of readmission whereas living rurally and higher confidence in medication purpose have a smaller risk.

Excluding Emergency Department Visits

When emergency department visits were excluded from readmissions the percentage of participants experiencing an event dropped to 36% with 19% of those occurring within a month (refer to figure 4). However, differences between readmitted and not readmitted participants were still insignificant.

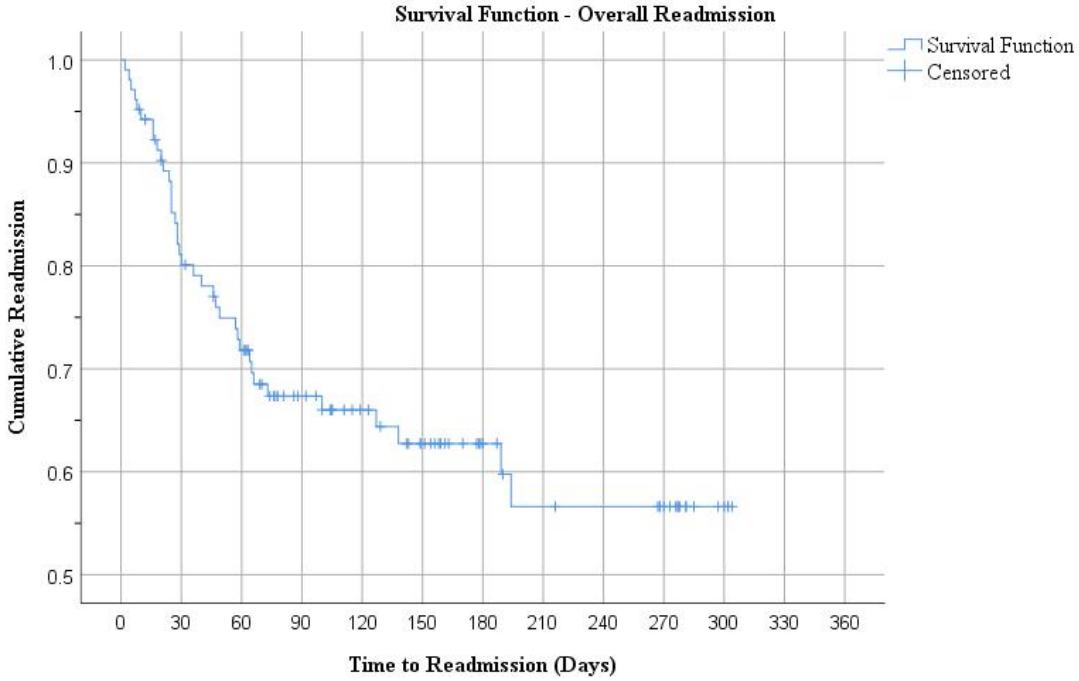

Figure 4. Kaplan Meier curve showing the time to readmission over the study period once emergency department visits were excluded.

Participants' confidence in the purpose of taking their medications 1 month after discharge was significantly associated with time to readmission (figure 5) although the group 'not confident at all' had only 2 participants. In order to have more even groups, it was split into a binary response of 'completely confident' or 'not completely confident' however, this was found to be insignificant.

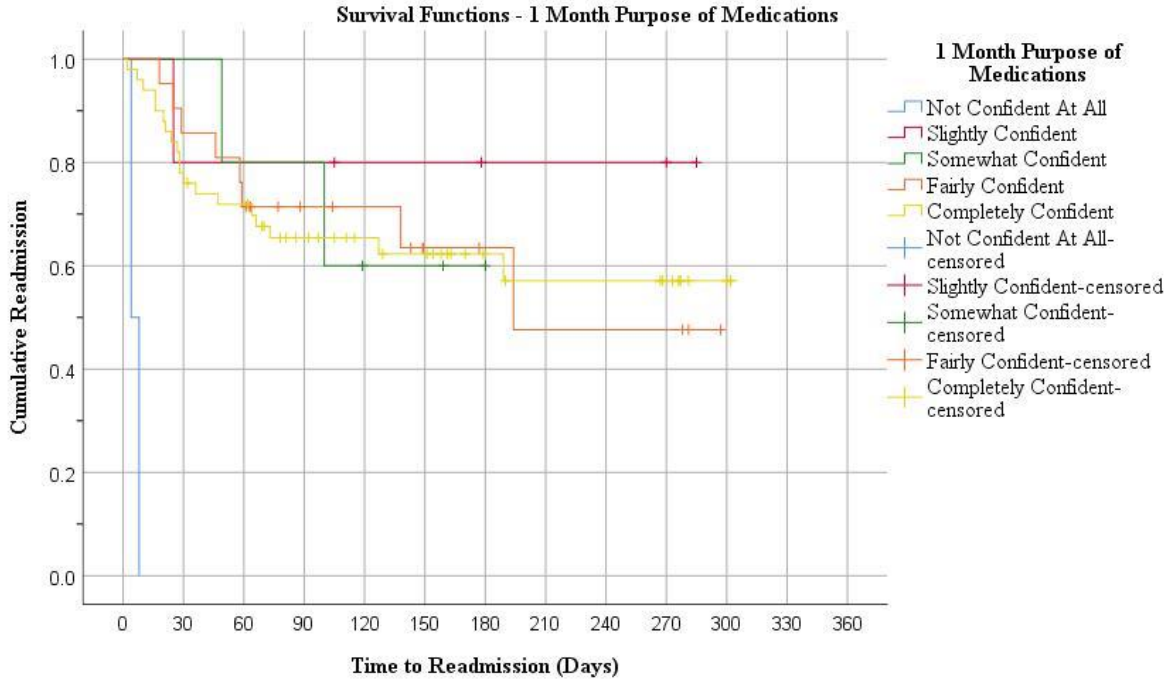

Figure 5 Kaplan Meier curve showing the time to readmission based on the responses to the 1-month follow up questionnaire n=80, $p<0.001$.

Neither the multivariate Cox Regression analysis for time to readmission nor the multivariate binary Logistic Regression for readmission within 30 days produced significant results once emergency department visits were excluded as readmissions.

Discussion

The percentage of participants with polypharmacy in this study was 97% and extremely high; a study investigating polypharmacy in inpatients ≥65 years of age reported 60% of participants with polypharmacy.[6] Furthermore, analyses of polypharmacy in Australians aged ≥70 and ≥50 reported polypharmacy in 36.1%[36] and 43.3%[37] respectively. These studies did not solely investigate diabetics which may contribute to the differences as the prevalence of polypharmacy has been shown to be higher in diabetics.[26] However this

study still observed higher rates of polypharmacy than other diabetic investigations.[10] This large prevalence of polypharmacy meant there was insufficient data to assess the hypothesis as the non-polypharmacy group was too small. This is a limitation of the study and may be overcome by pre-screening participants based on medication numbers in future. However, the concept of new polypharmacy observed here and contradictory results from Best et al. of decreased polypharmacy between admission and discharge[6] also need to be considered if this route is taken. Decreasing the age of inclusion may also help with heterogeneity of the study population however then the medication assessments used would be less valid.[28, 30, 31]

Although large in quantity, the medications prescribed were largely appropriate as determined by the low median scores for the Beers Criteria, ARS and DBI which is a positive result. These scores were also lower than reported in the literature for similar studies[6, 7, 26] and it has also been shown that the Beers criteria scores lower in diabetics compared to non-diabetics.[26] Medications may still play a role in readmission as participants confidence in the purpose of taking their medications was shown to be significantly associated with time to readmission. However, this may be due to chance alone given the small number of participants reporting 'not confident at all' and this research should be repeated to validate this finding.

The lack of significant findings may be due to how the primary outcome was measured. Similar studies have included emergency department visits as readmissions[18] whereas others have not specified[7]. In this study ED visits likely provided noise around the outcome of readmissions yet removing them may have made the signal of readmission too weak. The readmission rate of 47% and 30% within 30 days is slightly higher than other studies however once emergency department visits were removed the rate of 19% within 30-days is comparable with the literature which ranges from 16-24.6%.[7, 14, 15, 19] However these studies also reported larger sample sizes. Readmissions were collected from OACIS which only includes data for public hospitals, therefore, there are potentially other readmissions that were missed which presents a flaw in the data. The stress subscale of the DASS21 was found to be significantly associated with time to readmission. A study investigating the DASS21 in elderly diabetic patients found stress to be predictive of readmission.[38] This does not support this study which showed lower rates of stress significantly associated with time to readmission. However, Alavi et al. reported a mean stress score of 19.27[38] which was much higher than the median score of 4.0 reported here and may explain these conflicting results.

The results of the multivariate analysis presented in table 4 are mostly consistent with the literature. Hypertension has been shown to be a risk factor for readmission in cardiovascular patients[39] whereas in diabetic patients it was associated with a reduction in the probability of 30-day readmission.[7] Sukumar et al. found that rural patients are hospitalised less for falls but were more likely to be readmitted within 28-days for than metropolitan residents.[40] The Australian Institute of Health and Welfare reported people in very remote areas needing almost twice as many hospitalisations that residents of major cities.[41] These findings are not reflected in the multivariate model which indicates rural participants having a lower hazard of readmission. This is discrepancy is likely due to an inability to collect readmission data for rural participants as rural hospitals are not listed on OACIS. Future studies may benefit from excluding rural participants to avoid this. A study which investigated student pharmacists providing medication reconciliation showed those who received the service had higher confidence in the purpose of their medications and lower readmissions after 60 days.[34] This supports the findings that for every one-point increase in confidence in medication purpose participants were almost a third less likely to be readmitted (hazard ratio 0.727, p=0.036). Lastly there is limited data for the individual components of the Edmonton Scale however, a study which used the same modification of the Reported Edmonton Frailty Scale (REFS) as discussed here, found the odds of readmission increased by 1.12 per one unit increase in the REFS.[42] Similarly it was found that the greater the number of functional deficits participants had a hazard ratio of 1.502 for time to readmission (p=0.011). These results are useful but given the limitations of the data further research is required.

A strength of this study was its prospective design although, its small sample size and single location mean the generalisability is low. The time frame and design of the study meant that participants had varying lengths of follow up which may have contributed to signal issues with readmission as an outcome measure. This should be rectified in future studies by allowing for a longer follow-up period so that more similar amounts of data are available for all participants. A longer study would also allow for inclusion of drug-related readmissions as an outcome measure as the coding for this data means the information is not available at the time of readmission. Another positive of this investigation is that it allowed for the creation of a rich data set of a complex population which can be analysed with different focuses for future studies, however, the assessments had varying levels of compliance meaning the sample size for some is quite small.

Conclusion

The level of polypharmacy observed was higher than the general Australian population[36, 37] and other diabetic populations.[10] The data collected were biased towards more complicated patients and were insufficient to investigate the hypothesis, however the results of the study are still useful and comparable with the literature. This research provides valuable insight into the levels of polypharmacy and prescription of potentially inappropriate medications in the sample population. The data is also useful for understanding readmission rates and presentations to emergency departments at public hospitals in this population. The multivariate model for time to readmission needs further research, however, may prove useful for targeting care integration interventions. There were several limitations with this investigation however these can be overcome with improved study design in future research which is necessary given the complexity of the population of interest.

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